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ABSTRACT

This manual describes the major forest types, the major species, seed orchards, and tree nurseries. Methods of identifying forest insect pests and diseases are given. The most common types of insecticides, fungicides, and herbicides are described. Both sprayer and granular applicator methods are discussed. Environmental considerations are presented. (BB)

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FOREST PEST CONTROL

This manual was developed in cooperation with the Georgia Department of Agriculture.

V. Rodney Coleman
February 27, 1975

SE 024 701

This training manual is intended to provide you with the information you will need to meet the standards of the Environmental Protection Agency for pesticide certification, and prepare you to take an examination given by the State Department of Agriculture based on this manual. It is not intended that this training will provide you with all the information you need for effective Forest Pest Control. Additional information in the form of publications and short courses can be obtained from the Cooperative Extension Service.

Appreciation is expressed to Mr. George D. Walker, Extension Forester, for assistance.

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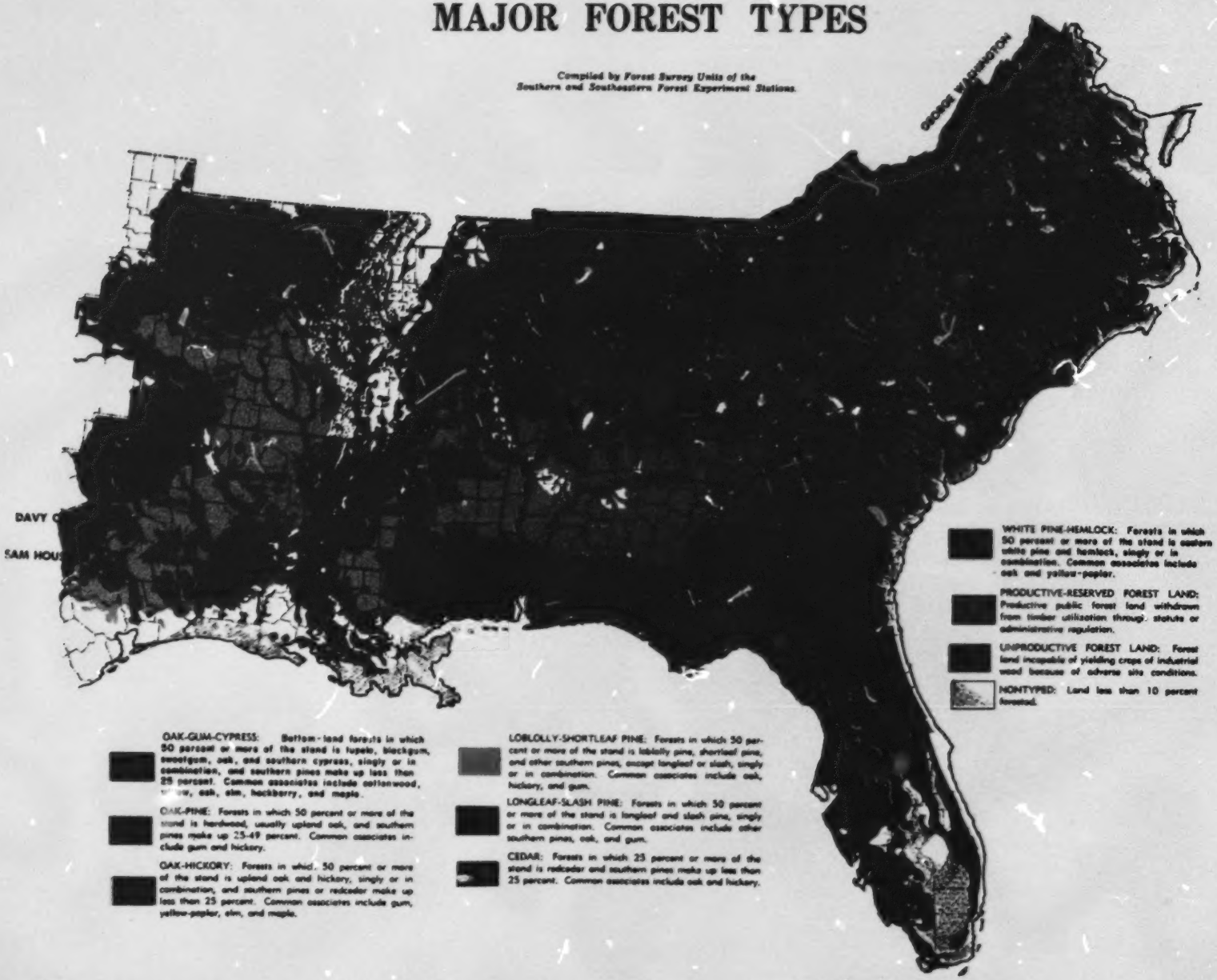
MAJOR FOREST TYPES

Compiled by Forest Survey Units of the Southern and Southeastern Forest Experiment Stations.



OAK-GUM-CYPRESS: Bottom-land forests in which 50 percent or more of the stand is tupelo, blackgum, sweetgum, oak, and southern cypress, singly or in combination, and southern pines make up less than 25 percent. Common associates include cottonwood, willow, ash, elm, hackberry, and maple.

OAK-PINE: Forests in which 50 percent or more of the stand is hardwood, usually upland oak, and southern pines make up 25-49 percent. Common associates include gum and hickory.

OAK-HICKORY: Forests in which 50 percent or more of the stand is upland oak and hickory, singly or in combination, and southern pines or redcedar make up less than 25 percent. Common associates include gum, yellow-poplar, elm, and maple.

LOBLOLLY-SHORTLEAF PINE: Forests in which 50 percent or more of the stand is loblolly pine, shortleaf pine, and other southern pines, except longleaf or slash, singly or in combination. Common associates include oak, hickory, and gum.

LONGLEAF-SLASH PINE: Forests in which 50 percent or more of the stand is longleaf and slash pine, singly or in combination. Common associates include other southern pines, oak, and gum.

CEDAR: Forests in which 25 percent or more of the stand is redcedar and southern pines make up less than 25 percent. Common associates include oak and hickory.

WHITE PINE-HEMLOCK: Forests in which 50 percent or more of the stand is eastern white pine and hemlock, singly or in combination. Common associates include oak and yellow-poplar.

PRODUCTIVE-RESERVED FOREST LAND: Productive public forest land withdrawn from timber utilization through statute or administrative regulation.

UNPRODUCTIVE FOREST LAND: Forest land incapable of yielding crops of industrial wood because of adverse site conditions.

NONTYPED: Land less than 10 percent forested.

FOREST PEST CO[illegible]

A. Types of Forests

1. Major forest types - The Southeast's varied climate and site conditions have contributed to the large number of tree species found. There are about 250 different native trees. Almost half are considered commercially important. There are five major forest types:

   a. Longleaf-Slash Pine - This type occurs in the Lower and Middle Coastal Plain. Its stands are 50 percent or more longleaf and slash pine, singly or in combination. Other trees commonly associated include other southern pines, oaks, and gums.

   b. Loblolly-Shortleaf Pine - This is found in most of the Piedmont and Upper Coastal Plain. Its stands are 50 percent or more loblolly pine, shortleaf pine, and other southern pines, except longleaf or slash, singly or in combination. Common associates include oaks, hickories, and gums.

   c. Oak-Pine - This is found primarily in the transition zone between the Piedmont and Mountain and Valley areas. It is also a later stage of plant succession throughout the state. Its stands are 50 percent or more hardwood, usually upland oaks. Southern pines make up 25-49 percent. Other trees commonly associated include gums and hickories.

d. Oak-Hickory - This is the primary forest type of the Mountain and Valley areas. Its stands are 50 percent or more upland oaks and hickories, singly or in combination. Southern pines or redcedar comprise less than 25 percent. Common associates include gums, yellow-poplar, elms, and maples.

e. Oak-Gum-Cypress - This is found primarily along major stream bottoms and swamps of the Coastal Plain. Stands are 50 percent or more tupelo, blackgum, sweetgum, oaks, and southern cypress, singly or in combination. Southern pines make up less than 25 percent. Other trees commonly associated include cottonwood, willow, ashes, elms, hackberry and maples.

2. Major Species - Due to past land management practices, most topsoil in the Piedmont area of the South is near depletion. As expected, soil quality has deteriorated. An estimated 80 percent of the land area is best suited for pine production. Pines can better cope with poorer soil conditions than hardwoods. The remaining 20 percent, primarily bottomland areas, coves, and lower slopes, are well suited for growth of hardwoods.

a. Commercial species - Pines are the most important commercial species because of existing site conditions and the stages of plant succession. Currently, most forest industries depend on pine. The four major species of pine are slash, loblolly, longleaf, and shortleaf. All are classed as southern yellow pines.

Another conifer of importance in the Southeast is bald-cypress. It is restricted to bottomland, pond, or swamp areas of the Coastal Plain.

Oaks are the major commercial hardwoods. Most important are white oak, northern red oak, and southern red oak. Yellow-poplar and sweetgum are the most important species used by the furniture industry and in veneer manufacturing. Blackgum and water tupelo are also important in veneer manufacturing. Sycamore is also commercially important.

3. Seed Production - In the early stages of the tree improvement program, selected forest areas were set aside for seed production. These areas were rogued of inferior species and trees that did not possess desirable characteristics. Seed orchards were then established from grafts of trees possessing superior qualities. At present, all loblolly pines planted in nurseries are of seed orchard origin. Approximately half the slash pine seedlings are from this same seed source. Other species are grown in seed orchards, and it is anticipated that in the near future almost all nursery seed will be obtained from these sources.

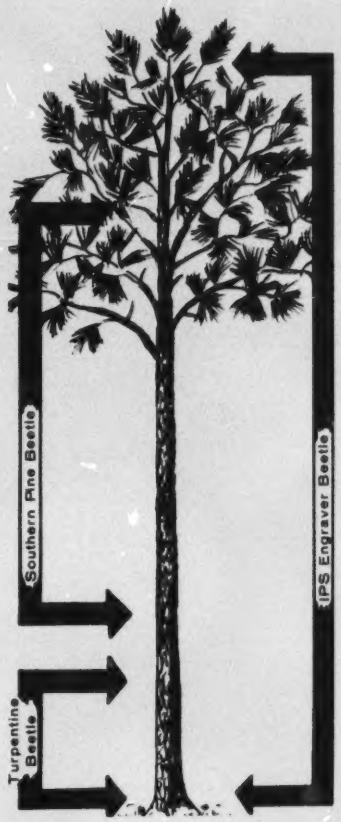
4. Tree Nurseries - There are many large nurseries located in the southeast for the production primarily of pine species. Several species of pines lend themselves well to seedling production for re-forestation purposes. Since pines are used predominantly for pulpwood and saw timber and grow extremely well in the southeast, the demand for pine seedlings is great. Nurseries for pine seedling production are very large, and the latest techniques for the production of strong, health seedlings are employed.

B. Pest Identification

Interest in the protection of forests from pests (insects, diseases, etc.) has grown in recent years. This has come about largely because of increased awareness of the destructive capacities of pests and the heavy toll they take of our supplies of commercial timber. Many people have come to realize that much damage should not happen. With adequate knowledge of identification and biology, it should be possible to prevent or at least reduce timber losses. Trees in a vigorous condition are much better able to withstand harrassment by insect pests than devitalized trees.

1. Insects

The black turpentine beetle is the largest of the major southern bark beetles. It is 1/4 of an inch or more in length and the rear end of this beetle is rounded. The color is from reddish-brown to black. Large "pitch-tubes" are often present up to eight feet on the trunk. It attacks fresh stumps and living trees by boring through the bark and constructing galleries on the face of the sapwood where eggs are laid. Fifty to 200 eggs are laid in a group. They hatch into white larvae which feed on the inner bark. The beetle may girdle trees when several broods occur



Sections of the trunk which three types of bark beetles attack.

at approximately the same height, killing the trees. From 70 to 90 percent of the trees attacked by the beetle die. The entire life cycle takes from 2 1/2 to 4 months, depending on temperature. In the South, there are usually two generations and part of a third each year.

The southern pine beetle is the most destructive of the eastern species of pine bark beetles. It is a small reddish-brown to black beetle, about 1/8 of an inch in length and the rear end of the body is rounded like that of the black turpentine beetle. Small "pitch tubes" are sometimes present from soil line to about 2/3 the way up the trunk.

S-shaped Galleries

Adult beetles bore directly through the bark, mate, and the females begin to excavate S-shaped egg galleries in the inner bark. Eggs are deposited in niches on either side of these galleries and hatch into small legless grubs within four to nine days. The grubs mine for a short distance before boring into the outer bark where

they pupate. There are from three to seven generations per year depending on locality and weather. Soon after a tree is attacked, all the needles turn yellow and then brown. Drought seems to be associated with initiation of major outbreaks of this insect.

New brood emergence holes.

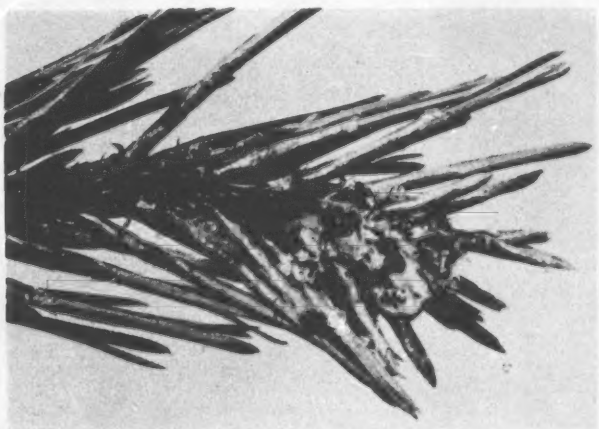
In addition to direct damage caused by the southern pine beetle, they introduce stain-causing fungi which invade the trees and hasten their death by clogging the water-conducting tissues. Death is hastened when they introduce blue-stain fungi.

Ips beetles are 1/8 to 1/4 of an inch in length and are yellowish, dark reddish-brown to black in color. They are easily recognized by their "scooped out" posteriors which are surrounded by varying numbers of tooth-like projections. In hot weather, it takes only 18-25 days to complete one generation. Populations of these beetles increase very rapidly during favorable conditions.

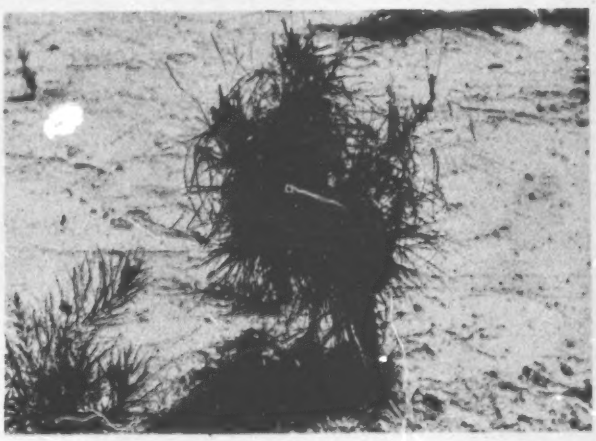
The fully grown larvae and pupae are yellowish white and vary from 1/3 to 1/4 inch in length. Gallery patterns are more or less Y or H shaped. The eggs are very small and white in color. Eggs are laid singly in small egg niches cut along the main tunnels. Upon hatching, the larvae feed in generally indistinct lines and larval feeding tunnels are usually filled with boring dust and frass.

Attacked trees are quickly girdled by the adults as they construct their egg galleries in the inner bark. Death is usually hastened by the introduction of blue-stain fungi which blocks the flow of sap. Small reddish tubes are frequently the first sign of attack, but they are usually absent in trees suffering from drought.

The importance of the pine tip moths on pine plantations and nurseries varies widely with tree species, host vigor, and environmental factors. Heavily infested trees may be severely stunted or deformed but mortality is rare. Generally, the tree grows out of the susceptible stage within a few years. In seed orchards, however, the tip moth is receiving increasing attention because of its impact on height growth and, more importantly, because of its effect on flower and cone production. All species of pines are attacked except white pine and longleaf pine.



Tip moth larvae protruding from heavily damaged pine shoot.

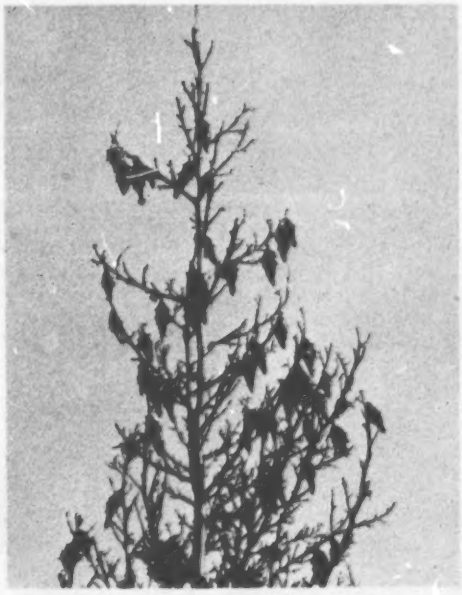


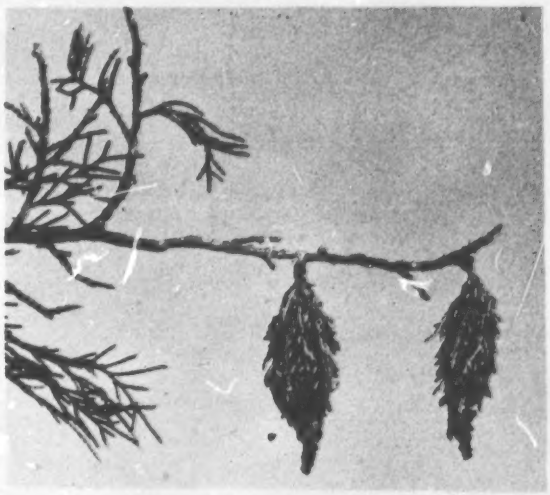
Young pine severely distorted and stunted by heavy tip moth infestations.

The adult moth is mixed grey and shiny copper colored with a wingspan of approximately 1/2 inch. The young larvae are light cream colored and mature larvae are light brown and approximately 3/8 inch long. Pupation occurs on the tree in the damaged terminal.

The bagworm is a pest that often attracts attention because of its unusual habits and appearance. It is generally recognized as a defoliator of conifers; particularly juniper, cedars and arborvitae but is also found on many hardwood trees

Damage is caused by the larvae which are inside the bags. The larvae eat the needles or leaves, and a heavy infestation can completely strip a plant of its foliage. Complete defoliation usually results in the death of the tree. Bagworms are easily identified by the spindle-shaped bags of silk, covered with bits of needles or leaves, that they construct around themselves.





Close-up of bags attached to twig.

Shrub killed by heavy infestation of bagworms.

The winter is passed in the egg stage. About 500 pale, whitish eggs are laid inside the protection of the bag by the female at the

end of the summer. She then drops to the ground and dies. Larvae hatch in the spring after the trees have their full foliage.

The male is a black, hairy moth. It measures about one inch across the spread wings. The female is whitish, worm-like, and has no wings or antennae. The male moths leave the bags and fly to bags containing females where mating takes place. There is only one generation of the insect each year.

Aphids are common pests on trees throughout the South. All southern pines are subject to attack by aphids. They are soft-bodied, usually wingless insects less than 1/8 inch in length. They may be pink, brown, black, whitish or greenish. The rate of development and reproduction of aphids is very rapid and many generations are produced each year.

Aphids feed by sucking plant juices usually from the tender, succulent parts of plants. Heavy feeding causes stunting of terminal buds, and needles become distorted or stunted. Often the first sign of attack is the presence of large numbers of aphids on the tree or branch. They excrete sweet, sticky honey dew which may attract ants in great numbers. A fungus, sooty mold, frequently develops on the honey dew and the branch or tree may appear black. Automobiles parked under heavily infested trees will frequently be covered with this sticky honey dew.

2. Diseases

Fusiform rust is one of the most important diseases on southern pines. The rust's most important impact is in nurseries, seed orchards, and young plantations. Loblolly and slash pines are very susceptible

to this rust. Longleaf pine is fairly resistant and shortleaf pine is highly resistant.

A fully developed limb canker.

The most easily recognized symptom is the spindle-shaped canker on the pine branches or main stem. In early spring these swellings appear yellow to orange as the fungus produces powdery spores. Older stem cankers may become flat or sunken as host tissue is killed. Cankers often girdle trees and wind breakage at the canker is common. Fungus spores from the pine infect oak leaves. Brown hair-like structures, produced on the underside of these leaves in late spring produce spores which in turn reinfest the pine trees, completing a "typical" rust cycle.

Avoid planting highly susceptible species such as slash and loblolly pines in areas of known high rust incidence. In these areas more resistant species such as longleaf or shortleaf pine should be planted. Pruning infected branches will prevent stem infection in young plantations. There should be a minimum of 14

inches between the infected portion and the trunk.

Littleleaf of pine is the most serious disease of shortleaf pine in the Piedmont region of the south. It is more severe on sites having poor soil aeration, low soil fertility and periodic moisture stress. The disease is most evident in older age trees, seldom attacking stands under 20 years old. The fungus attacks the root system and leads to a gradual reduction of growth and yellowing of needles.

Wise selection of the seed orchard site will greatly reduce problems with this disease. Avoid sites where littleleaf disease is a problem. Sites with poorly-drained soils with hard pans and those showing evidence of soil erosion should not be considered.

Inorganic fertilizers with at least 200 pounds of available nitrogen per acre when applied early in the spring will help in prevention of the disease in seed production.

Annosus root rot is prevalent throughout the south and is considered a severe disease problem in plantations. Pine seed orchards are vulnerable to this destructive root pathogen because trees are even-aged and closely spaced. Scars on roots and stems caused by the frequent use of vehicles and equipment and the fresh stump surfaces left from removing unsuitable trees, provide infection site for the disease.

A well developed conk at the ground line of a dying tree.

The fungus spreads from tree to tree by root contact and by wind borne spores. Root systems of infected trees are gradually reduced to a stringy white mass of decayed wood. Infected trees are subject to wind throw. The disease spreads in a circular pattern from an infection center and most infected trees are killed within three years.

A disease prevention program should be followed in seed orchards, for once a tree is infected there is no known cure. For example, limit vehicle movement as much as possible to reduce the chance of injuring roots near the ground surface.

C. Types of Pesticides

The purpose of a pesticide is to manage an undesirable organism in the environment. The challenge is to use pesticides in a manner that will cause the least harm to non-target organisms in the forest, seed orchards or tree nurseries.

1. Insecticides

Chlorinated hydrocardon insecticides are generally considered long residual chemicals. Their degradation or break-down to other compounds may take years. Chlordane, BHC, and lindane are examples for this group. These materials have been and are still used for the control of certain insect pests.

Chlorinated hydrocarbon insecticides are not harmful to trees when used according to label directions. They can be harmful, however, to some wildlife forms and some animals accumulate them in their fatty tissues.

Organic phosphate insecticides are used for the control of several forest insect and mite pests. In general, they are rapid-acting insecticides that have a short residual life. They usually cause little trouble from residues remaining in the soil. Organic phosphate insecticides are not nearly as likely as the chlorinated hydrocarbon insecticides to accumulate in animal tissues. They do, however, tend to be much more acutely toxic to man and other warm blooded animals than chlorinated hydrocarbons.

Carbamates - This group of insecticides has the same general effects as the organic phosphates.

2. Fungicides

Those fungicides used in forest tree cultures have little effect on the immediate environment.

Persons working with Thiram treated seeds should avoid alcohol consumption while in the proximity of those seed. Alcohol in the blood plus inhibition caused by Thiram dust can lead to acute medical problems.

3. Herbicides

Cultivation is used extensively for the control of weeds in tree nurseries.

D. Methods of Application

It is desirable to apply all pesticides in such a manner that they reach the target organism with the least possible harm or accumulation in the forest environment. Less drift is likely with ground sprayer and granular application than with aerial application. You should select the right kind of equipment.

1. Sprayers

Always choose a sprayer on the basis of what you want it to do. You should read and follow the operator's manuals for all your sprayer equipment. They will tell you exactly how to use and care for it. Always rinse out the entire system after each use. Remove and clean nozzles, nozzle screens, and strainers. Make sure nozzles are all of the same type and size.

2. Granular Applicator

This type of applicator allows for more exact placement of pesticides than most other methods of application. Choose a granular applicator that is easy to clean and fill. It should have good agitation over the outlet holes. Application should stop when drive stops even if outlets are still open. Do not travel too fast for conditions because bouncing equipment will cause the application rate to vary.

E. Protecting the Environment

It is becoming increasingly important to understand the total impact of pest control activities on the forest and the adjacent environment. The need to minimize the possibility of secondary problems such as unintended effects on wildlife must be understood by the pesticide applicator.

1. Beneficial forest insects are represented by a great many species, some of which are very abundant. Some feed on forest debris and aid in its deterioration, others feed on organic matter in the duff and soil and contribute to improvements in soil fertility. Some contribute to stand improvement by attacking and killing declining, diseased, or over mature trees and making way for younger growing stock. Many others are parasites or predators of destructive species of insects.

2. Biological magnification has resulted from the use of some chlorinated hydrocarbon insecticides for insect control on trees. It has been found in the coastal environment, that several species of animals are harmed by some pesticide chemicals. Worms, for example, form an important part of the diet of many aquatic species. Pesticides stored in the fatty tissues of some animals have been found to be passed along to higher forms of animal life when consumed.
3. The pesticide label is perhaps the most important guide to the use of a chemical; in fact, to use the material in a manner inconsistent with label directions is illegal. The label will provide information on the harmful effects that may occur on non-target species of wildlife such as fish and honey bees. Many spray and dust formulations should be applied during early morning hours or late afternoon when wind movement is very low. This will help prevent the drift of pesticides to adjacent food or feed crops or into lakes. Instructions for the use of special types of clothing to wear during applications will be included.
4. If there is a fish or wildlife kill in areas adjacent to pesticide applications, contact the appropriate agency such as the Georgia Department of Natural Resources in Georgia so they may investigate the reason for such kills.

   There are many other conditions that can kill fish and wildlife that have no relationship to pesticides. Harmful conditions should be investigated in order to prevent future occurrences.
5. Controlled ground burning is sometimes utilized by foresters for the control of undesirable tree species, diseases, and insects that would otherwise prevent desired tree species from developing to their full

potential. This practice also prevents wild fires which could have a devastating effect on the environment. Controlled burning does not leave undesirable pesticide residues in the environment that could cause damage to fish and wildlife.

6. There are several meteorological factors associated with forest aerial applications that could cause environmental hazards. The drift of a long residual pesticide into adjacent lakes and streams is an example. However, most chemicals used for the control of forest pests in the southeast are applied with ground equipment which dispenses the chemical in close proximity to the target pest.

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